Claims

WE CLAIM:

1. A method of modeling circulation in a living subject, such method comprising the steps of:

developing a model for living subjects in general;

correcting the model to substantially conform to the overall cerebral physiology of the living subject; and

calculating a cerebral flow of the living subject based upon the corrected model and a selected cerebral blood flow perturbation.

2. The method of modeling as in claim 1 wherein the step of developing the model further comprises adopting the Circle of Willis.

3. The method of modeling as in claim 1 wherein the step of correcting the model further comprises selecting a vessel of the model.

4. The method of modeling as in claim 3 wherein the step of selecting a vessel of the model further comprises identifying a general area of a corresponding vessel in an image of the living subject.

5. The method of modeling as in claim 4 wherein the step of identifying the corresponding vessel further comprises localizing the corresponding vessel in 3-dimensional space.

6. The method of modeling as in claim 5 wherein the step of localizing the corresponding vessel further

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comprises measuring a ~~diameter of the corresponding vessel.~~ using an Attention-Based Model

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7. The method of modeling as in claim 6 wherein the step of processing pixel data of the general area of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue further comprises tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

8. The method of modeling as in claim 7 further comprising updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.

9. The method of modeling as in claim 8 wherein the step of calculating the cerebral flow further comprises using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.

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10. The method of modeling as in claim 9 wherein the step of calculating the cerebral flow further comprises using a Navier-Stokes momentum equation.

11. The method of modeling as in claim 9 wherein the step of calculating the cerebral flow further comprises using an equation of state relating a local pressure to a local artery size.

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~~12. Apparatus for modeling cerebral circulation~~ in a living subject, such apparatus comprising:

a cerebral circulation model for living subjects in general;

means for correcting the model to substantially conform to the ~~overall~~ cerebral physiology of the living subject; and

means for calculating a cerebral flow of ~~the~~ living subject based upon the corrected model and a selected cerebral blood flow perturbation.

13. The apparatus for modeling as in claim 12 wherein the cerebral circulation model further comprises the Circle of Willis.

14. The apparatus for modeling as in claim 12 wherein the means for correcting the model further comprises means for selecting a vessel of the model.

15. The apparatus for modeling as in claim 14 wherein the means for selecting a vessel of the model further comprises means for identifying a general area of a corresponding vessel in an image of the living subject.

16. The apparatus for modeling as in claim 15 wherein the means for identifying the corresponding vessel further comprises means for localizing the corresponding vessel in 3-dimensional space.

17. The apparatus for modeling as in claim 16 wherein the means for localizing the corresponding vessel further comprises means for measuring a diameter of the corresponding vessel.

18. The apparatus for modeling as in claim 17 wherein the means for processing pixel data of the general area of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue further comprises means for tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

19. The apparatus for modeling as in claim 18 further comprising means for updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.

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20. The apparatus for modeling as in claim 19 wherein the means for calculating the cerebral flow further comprises means using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.

21. The apparatus for modeling as in claim 20 wherein the means for calculating the cerebral flow further comprises means using a Navier-Stokes momentum equation.

22. The apparatus for modeling as in claim 21 wherein the means for calculating the cerebral flow further comprises means using an equation of state relating a local pressure to a local artery size.

23. Apparatus for modeling cerebral circulation in a living subject, ~~such apparatus~~ comprising:

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a cerebral circulation model for living ~~subjects in~~ general;

a correction processor adapted to correct the model to substantially conform to the overall cerebral physiology of the living subject; and

a flow processor adapted to calculate a cerebral flow of the living subject based upon the corrected model and a selected cerebral perturbation.

24. The apparatus for modeling as in claim 23 wherein the cerebral circulation model further comprises the Circle of Willis.

25. The apparatus for modeling as in claim 23 wherein the correction processor further comprises a cursor adapted to select a vessel of the model.

26. The apparatus for modeling as in claim 25 wherein the correction processor further comprises a pixel processor adapted to process pixel data of the general area of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue.

27. The apparatus for modeling as in claim 26 wherein the pixel processor further comprises a distance processor adapted to measure a diameter of the corresponding vessel.

28. The apparatus for modeling as in claim 27 wherein the pixel processor further comprises a tracing processor adapted to trace the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

29. A method of modeling a surgical alteration of cerebral circulation in a living human subject, such method comprising the steps of:

developing a model for living subjects in general;

correcting the model to substantially conform to the cerebral physiology of the living subject;

perturbing the corrected model; and

determining a set of flow changes occurring as a result of the perturbation.

30. The method of modeling as in claim 29 wherein the step of developing the model further comprises adopting the Circle of Willis.

31. The method of modeling as in claim 29 wherein the step of correcting the model further comprises selecting a vessel of the model.

32. The method of modeling as in claim 31 wherein the step of selecting a vessel of the model further comprises identifying a general area of a corresponding vessel in an image of the living subject.

33. The method of modeling as in claim 32 wherein the step of identifying the corresponding vessel further comprises localizing the corresponding vessel in 3-dimensional space.

34. The method of modeling as in claim 33 wherein the step of localizing the corresponding vessel further

comprises measuring ~~a~~ diameter of the corresponding vessel.

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35. The method of modeling as in claim 34 ~~wherein the~~ step of processing pixel data ~~of the~~ general area of the corresponding vessel ~~to~~ locate a boundary area between the corresponding vessel and surrounding tissue further comprises tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

36. The method of modeling as in claim 35 further comprising updating the model based upon ~~the~~ measured diameter and locations of the respective ends of corresponding vessel.

37. The method of modeling as in claim 36 wherein the step of calculating the cerebral flow further comprises using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.

38. The method of modeling as in claim 38 wherein the step of calculating the cerebral flow further comprises using a Navier-Stokes momentum equation.

39. The method of modeling as in claim 38 wherein the step of calculating the cerebral flow further comprises using an equation of state relating a local pressure to a local artery size.

40. Apparatus for modeling a surgical alteration of cerebral circulation in a living human subject, such apparatus comprising:

a cerebral model for living subjects in general;

means for correcting the model to substantially conform to the cerebral physiology of the living subject;

means for perturbing the corrected model; and

means for determining a set of flow changes occurring as a result of the perturbation.

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41. The apparatus for modeling as in claim 40 wherein the means for correcting the model further comprises means for selecting a vessel of the model.

42. The apparatus for modeling as in claim 41 wherein the means for selecting a vessel of the model further comprises means for identifying a general area of a corresponding vessel in an image of the living subject.

43. The apparatus for modeling as in claim 42 wherein the means for identifying the corresponding vessel further comprises means for localizing the corresponding vessel in 3-dimensional space.

44. The apparatus for modeling as in claim 43 wherein the means for localizing the corresponding vessel further comprises means for measuring a diameter of the corresponding vessel.

45. The apparatus for modeling as in claim 44 wherein the means for processing pixel data of the general area

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of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue further comprises means for tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

46. The apparatus for modeling as in claim 45 further comprising means for updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.

47. The apparatus for modeling as in claim 46 wherein the means for calculating the cerebral flow further comprises means using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.

48. The apparatus for modeling as in claim 47 wherein the means for calculating the cerebral flow further comprises means using a Navier-Stokes momentum equation.

49. The apparatus for modeling as in claim 48 wherein the means for calculating the cerebral flow further comprises means using an equation of state relating a local pressure to a local artery size.

50. A method of modeling a surgical alteration of circulation in a predetermined region of a living human subject, such method comprising the steps of:

developing a model of the region for living subjects in general;

correcting the model to substantially conform to the physiology of the region of the living subject;

~~perturbing the corrected model; and~~

determining a set of flow changes occurring as a result of the perturbation.

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